Effects of turbulent flow on the movement of larval sand dollars

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Populations of many benthic invertebrates are maintained by dispersal of planktonic larvae, which are typically weak swimmers but are nonetheless able to regulate their dispersal by moving to different depths in the water column. It is likely that the biomechanics of larval swimming, larval behavior, and passive transport all contribute to the vertical position of larvae in the water column, however the specific details of how larvae choose and maintain vertical position in the water column are poorly understood. A recent theoretical model suggests that the interaction between turbulent motion, and larval morphology and swimming behavior can affect the movement of pluteus-like larvae in predictable ways. The objective of this study is to investigate empirically how the movement of various morphologies of larval sand dollars, Dendraster excentricus, is affected by shear and turbulent flows. We observed larval movement in both simple shear flows and more complex turbulent flows at levels comparable to those the larvae would likely encounter in nature. We used flow visualization and computerized particle tracking of both larvae and flow markers to quantify effects of flow on movement.